TOP SECRET

3009

NRO REVIEW COMPLETED

CONTROL NO. OXC 1497

REFERRED TO OFFICE	RECEIVED			RELEASED		SEEN BY	
	SIGNATURE	DATE	TIME	DATE	TIME	NAME & OFFICE SYMBOL	DATE

(OVER)

Handle Via Indicated Controls

25X1A [redacted]

Access to this document will be restricted to those persons cleared for the specific projects;

OXCART

WARNING

This document contains information affecting the national security of the United States within the meaning of the espionage laws U. S. Code Title 18, Sections 793 and 794. The law prohibits its transmission or the revelation of its contents in any manner to an unauthorized person, as well as its use in any manner prejudicial to the safety or interest of the United States or for the benefit of any foreign government to the detriment of the United States. It is to be seen only by personnel especially indoctrinated and authorized to receive information in the designated control channels. Its security must be maintained in accordance with regulations pertaining to [redacted] Control System.

NRO 25X1

DECLASS REVIEW BY NIMA / DoD

TOP SECRET

GROUP 1
Excluded from automatic downgrading and declassification

(CONTINUED)

REFERRED TO OFFICE	RECEIVED			RELEASED		SEEN BY	
	SIGNATURE	DATE	TIME	DATE	TIME	NAME & OFFICE SYMBOL	DATE

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

OXC-7497
COPY 2 OF 3

25X1A

ENGINEERING REPORT NO. 7788

COHERENT LIGHT ENLARGER

INTERIM ENGINEERING REPORT

DATE: 21 August 1964

PREPARED FOR:

25X1A

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

TABLE OF CONTENTS

COHERENT LIGHT ENLARGER

INTERIM ENGINEERING REPORT

A. INTRODUCTION

This interim engineering report on the coherent light enlarger is being submitted on the occasion of the customer's acceptance test. A final report will be submitted following delivery of the instrument to the customer's facility.

The purpose of this report is to compare the presently attained performance with the original objectives, and to indicate the extent to which those objectives have been achieved. The original objectives, as described or implied in the contract proposal (Ref. 1), are itemized below. Some items not specified in the proposal are also discussed and evaluated in this report, as are a few items relating to the breadboard instrument for which there was no separate report.

B. ORIGINAL OBJECTIVES

The general purpose of this instrument is to provide a means of making enlargements of very high-resolution, low-contrast photographs without loss of detail over a reasonable format size, and on a production basis. To accomplish this purpose the instrument need only provide a 4X intermediate enlargement of the original image. At this magnification existing equipment can extract all image detail.

Specific items are as follows:

25X1B

1. Transfer Function

[redacted]

*200 l/mm at the input negative

2. Format Size

The input format should be a 2-1/4-inch square; the output a 9-inch square.

3. Coherent Illumination, Laser

It was stated as the basis of the proposal that in order to achieve the desired transfer function and format size with a practical lens design coherent illumination would be employed. Further, it was shown that a helium-neon continuous laser would yield the desired degree of coherence and practical exposure times.

4. Viewing and Selecting

Provision for viewing and selecting areas for enlargement from any 2-1/4-inch square on a roll of film up to 9-1/2-inch wide should be included.

5. Production Rate

The instrument should "be compatible in speed and mode of operation with utilization as a production machine to enlarge entire rolls of negatives".

6. Spatial Filtering

Capacity to perform spatial filtering should be included. (Note: Filtering as such need not be demonstrated.)

7. Structural Requirements

The instrument should have sufficient structural stiffness and be sufficiently isolated from floor vibrations as to make possible enlargements free of mechanical blur.

8. Liquid Gate

As part of the breadboard phase, the requirements of the liquid gate were to be investigated and evaluated in terms of general suitability and safety.

9. General Acceptability

In addition to the above, a good instrument should perform its function in a reasonable manner, not requiring excessive startup time; unusual strength or coordination of the operator, etc.

C. BRIEF REVIEW OF THE PROJECT: THE BREADBOARD

The initial efforts were concentrated on the breadboard, which was to demonstrate feasibility and to uncover hidden problems.

It was determined that a wider latitude than anticipated existed in liquid index matching requirements (Ref. 2), and that several liquids were available which could be handled safely and without damage to the film.

Use of the laser resulted in the appearance of artifacts* and reflection interference patterns at the image plane. The first photographs were unusable for this reason. Attempts to eliminate these defects by either reducing coherence or by "moving" the source lamp may be summarized as follows:

(a) Use of a fixed diffusing screen near the collimator lens.

(b) Use of a diffusing screen near the collimator having a random motion.

(c) Use of a plane parallel wobble plate (random motion) between the condenser and the collimator.

(d) Use of moving "sandwich" diffusing screen at the focal point of the collimator.

Method (a) resulted in a shadowgraph of the diffuser grain on the image plane and was therefore useless. Method (b) yielded good photographic results but reduced coherence so that spatial filtering could not be achieved. Method (c) permitted spatial filtering but did not eliminate artifacts as effectively as (b). Method (d) (which developed after the breadboard "acceptance") offered the greatest promise; it appeared possible to use a simple

*Image blemishes caused by diffraction by dust particles or microscopic defects in the glass elements.

rotational motion (rather than random) providing a condensing lens was used to focus the laser light on the screen. The size of the image produced by the condensing lens determined the degree of coherence. The purpose of the "sandwich" was to reduce the scattering angle of the diffuser.

Very good results were obtained with methods (b) and (d), better than the breadboard was expected to yield. It appeared that a 5-percent departure from full coherence yielded optimum results in terms of resolution and freedom from artifacts. One advantage of the departure from full coherence is the reduced sensitivity to lens surface defects and dust particles, except at the object plane (liquid gate). Near this plane any defect interferes with image quality; antiferrotyping backings on the input film <u>must</u> be removed (household bleach can be used).

Since 100 percent coherence did not yield best results for the breadboard, it was decided that the prototype should include a second source, the coherence of which could be varied. A zinc vapor lamp was tried, but found to require long exposure. A sodium vapor lamp, used with an isolation filter (λ 5890A), proved more satisfactory. See Appendix A.

The modulation transfer function of the breadboard was never determined. Attempts made, using normal procedures for incoherent light, were fruitless; and no agreement was reached at that time on proper methods for coherent or near-coherent light. Best resolution of three-bar targets, both high and low contrasts, was 144 l/mm without a spatial filter and 156 l/mm with an experimental spatial filter. Scenes enlarged on the breadboard showed more detail than scenes enlarged on the best conventional enlarger available here*.

The making of spatial filters has covered the entire time span of the project to date. These can be described as follows:

1. The first filter was made by applying a graduated coating of reflective aluminum to a glass plate over a small area (.070-inch diameter). It was with this filter that the results referred to above were obtained.

*Beseler with Componon f/5.6, 105 mm lens.

2. The second filter was made by coating aluminum on a glass plate over a much larger area (2.2-inch diameter). Very strong interference patterns resulting from the reflective coating led to the abandonment of this approach.

3. The third filter consisted of a pair of glass discs with a variable thickness gap between them. The gap was filled with a light absorbing liquid to produce the filtering effect. This filter was workable but quite difficult to make. See Ref. 3.

4. The fourth filter consisted of a photographic film so exposed that it demonstrated the proper variation of density with radius. This film was cemented in place between two optical flats and mounted in a cell. This method of manufacture appears to be the most reliable.

D. BRIEF REVIEW OF THE PROJECT: PROTOTYPE DESIGN AND FABRICATION

Design and fabrication of the prototype was a bit late in getting into full swing. Three items assumed major importance and considerably altered the final product as compared to the original concept. First, it was decided that the liquid gate would be made vertical so that the rest of the machine need not stand on end. Second, it was determined that the input film would be in rolls rather than single frames. Third, it was decided to employ servo systems to move the film across the liquid gate. The second and third items required major design and fabrication efforts. In addition, it was decided to provide light-tight covers so that the machine could be operated under normal room illumination conditions. The final change in concept involved inclusion of a data chamber which was not originally specified. Despite the above concept changes, the instrument was substantially assembled by the required date and within the allowed costs.

Optical performance of the prototype was found to present difficulties even before the final assembly phase was reached. The assumption that "objective" quality glass, ground and polished to very fine surface tolerances, would be free of artifacts when used with coherent illumination was found to be overly optimistic. In addition, one of the assembled lenses was found to have less-than-theoretical resolution. A great deal of effort was spent inspecting and aligning this lens with the result that resolution was somewhat improved.

E. CURRENT STATUS

The current status (Mid-August, 1964) in regard to each of the original objectives is listed below:

1. Transfer Function

Tentative modulation transfer function information has been obtained using sine wave targets and various forms of illumination. Use of the laser or the sodium lamp at high coherence results in exposures having a "grainy" appearance. To avoid this, it has been found necessary to use a slow film (SO-243) and a fine grain, low contrast developer (D-76 diluted one to one). Unfortunately, no transfer function information is presently available from the manufacturer for this film-developer combination. Our first figures in this category indicated that the M.T.F. was at least 0.65 out to 200 cycles/mm. See Appendix B. The most recent work, unfortunately, has shown too much scatter to indicate a definitive test. See Appendix C.

Three-bar targets have also been used to evaluate resolution. These show that the resolution is better in the radial then in the tangential direction, and better in the center of the field (250 l/mm) than in the corners (225 l/mm radial, 65 l/mm tangential). See Appendix D. Note that the information contained in Appendix D was obtained using only high contrast targets. Many exposures were also made with low contrast targets, but no set of exposures yet made defines low contrast performance as clearly as has been done for high contrast.

Scenes enlarged by the instrument appear clear and sharp except for the presence of very small artifact circles. To eliminate these it might be necessary to destroy coherence to the point where spatial filtering would be impossible. The effect on the transfer function would also have to be determined. Further study on this point is needed when time permits.

2. Format Size

The format size is as required. However, this item may be subject to modification. (See item 10, below).

3. Coherent Illumination Laser

The use of partly coherent illumination has brought about a significant increase in transfer function at the higher frequencies. (See item 1, above). It has also brought about a host of new problems which must be grappled with. It is realized that the present method of utilization is by no means optimum, and the goal at this point must be to find a means of using full coherence while suppressing the artifact phenomenon. Further steps in this direction should be pursued in order to achieve still higher transfer function values.

At present, the instrument contains both a laser and a sodium lamp, each of which has a distinct advantage. The degree of coherence of the laser can be varied by changing the size of the spot of light focussed on the diffuser wheel (or by removing the diffuser wheel); while the degree of coherence of the sodium lamp can be varied by changing the opening of an iris diaphragm. The ease of adjustment of the iris permits the customer to experiment to determine the advantages of coherence.

The laser, as an enlarger light source, is not at this moment the darling of one short year ago. Because full coherence cannot be employed until the artifact problem is solved, the sodium lamp (for example) is on a competitive footing. However, as more effective means of eliminating artifacts are discovered, the advantages of the laser will again be sought. It is hoped that improved artifact elimination devices may be retrofitted to the present instrument at some near-future date.

4. Viewing and Selecting

The operator is able to view the film on a reflex screen. However, the requirement for selecting was altered by verbal communication with the customer. According to the present understanding, the film to be enlarged will first be reviewed by an interpreter; who, when choosing an area to be enlarged, will note the frame number and the coordinates of the area (measured from a corner of the frame) onto an instruction sheet. The enlarger operator, working from the instruction sheet, must then find the frame by number and move the reference corner of the frame to the optical axis by observing the reflex screen.

While the reference corner is at the optical axis, he sets two counters to zero. The counters, of course, are for measuring distances along the length and across the width of the film. The operator moves the film until the counter readings match the figures on the instruction sheet and then makes the enlargement. Means of following the above procedure have been adequately provided in the prototype.

5. Production Rate

The instrument is well suited to a high production rate and can make many enlargements in a comparatively short time. Several electrical interlocks have been provided to prevent damage to the input film or accidental exposure of the output film. Threading is simple; the joy stick control for film transport is quite sensitive; and all operating controls are within easy reach from the console after the startup sequence. Maximum film transport speed is approximately 100 feet per minute. The film drying cycle, that must follow each exposure because of the liquid gate, is automatic; as is also frame advance on the roll film output magazine. The major factor that would slow the production rate would be the removal of the antiferrotyping backing of the film. Other factors are that the operator cannot see the takeup spool, and that there is no automatic rewind provision.

The time required to make a print would vary with the location of the subject on the roll; the exposure required; and, of course, the abilities of the operator. Special treatment such as spatial filtering would fall into the category of experimentation.

6. Spatial Filtering

The capacity to perform spatial filtering has been provided both optically and mechanically. Optically, the spatial filtering plane exists in the clear space between the collimator and imaging lenses. The frequencies are separated as a function of radius, and the aperture is of reasonable working size. The light sources are sufficiently coherent as to make filtering possible. Mechanically, a filter holder has been provided, and it is mounted on a three directional micrometer stage to facilitate positioning.

7. <u>Structural Requirements</u>

The frame of the instrument consists of a sixteen-inch diameter, quarter-inch thick steel pipe on top of which is welded a thirteen-inch wide by seven-sixteenths-inch thick steel channel. The structure was stress relieved after welding. The frame is supported at three points, and is isolated from

25X1A floor vibrations by [redacted] pads [redacted] The sheet metal covers of

25X1A the instrument are attached to this frame and hang clear of the floor. All optical components are rigidly bolted to the top of the steel channel. It should be noted that the breadboard structure was similar except that it was partly filled with sand to deaden vibrations. Although the prototype frame was not filled with sand, no difficulty has been experienced either with deflection or vibration. Specifically, no enlargements have been found to suffer from mechanical blur.

8. <u>Liquid Gate</u>

The liquid gate of the breadboard consisted simply of two plane-parallel glass discs, between which a chip of film could be inserted. Liquid was injected by means of a hypodermic syringe, and the discs were bolted to a mounting plate with three studs. Removal of one chip, and insertion of another, took about five minutes. Once loaded, however, the breadboard gate assembly did show the advantages of the liquid gate principle. The problem for the prototype was to design a unit that would wet and locate the film in a few seconds.

The prototype liquid gate consists of one fixed and one movable plane-parallel glass disc, each facing the other and each surrounded by a soft seal which protrudes beyond the plane of the disc. Film passes between the two discs in a vertical plane. When the gate is to be closed, the movable disc moves toward the fixed disc carrying the film between. As the soft seals contact the film, liquid is injected into the bottom of the enclosed spaces and begins to rise. Air is vented from the tops of these spaces by ports. As the movable disc continues to carry the film toward the fixed disc, the enclosed volume diminishes and the liquid level rises rapidly. Finally, as the film is pressed home against the fixed disc, excess liquid is vented from the top ports. A single lever operates the movable disc and the liquid pump. An over-center toggle prevents opening until the control knob is pulled.

It is actually somewhat early to evaluate the operation of the liquid gate. Most of the enlargements made to date have been of chips or narrow strips that fill only a portion of the gate. Shortly after the gate is closed, the fluid drains out of the space surrounding such chips but the chips themselves remain wet on both sides. When wide rolls are placed in the gate, so that the edges overlap the gate, both surfaces will be properly wetted. However, when the lower edge of a roll is above the bottom of the gate, only one side is wetted on the first closing stroke, and a second closing stroke is required to wet the other side.

The mechnical effort required to close the gate is somewhat more than is comfortable. A simple solution to this problem is to provide a lever with increased mechanical advantage.

Although these developmental problems do exist, the increased accessibility and decreased instrument height gained by making the liquid gate vertical are felt to be compensating factors of considerable importance.

The use of a liquid gate required the provision of means for drying film and venting potentially dangerous vapors. These were provided by compressed air "knives" and exhaust blowers, respectively. To simplify operation, the drying cycle was made automatic.

9. General Acceptability

Considerable effort has been invested in making the machine simple and convenient to operate. Operation in ambient illumination and control from a single location are thought to be very valuable. The outer covers protect the optical components and are easily cleaned. Controls at the console are clearly labeled and the indicator lights show the operator the condition of the machine. The viewing screen orientation and one difficult-to-remove outer cover could be improved.

Items such as automatic exposure, automatic dodging, automatic output processing and preliminary removal of anti-ferrotyping backing could be of great usefulness and should be investigated as follow-ons after the general utility of the instrument has been proved.

10. Optical Performance

The optical performance of the instrument is discussed rather completely in Appendix D; additional information being offered in Appendices B and C. As mentioned previously, enlargements made on the instrument appear clear and sharp except where small artifacts are present.

Because the conventional means of measuring performance have not yielded clear results, two questions most urgently require answers at this time. These are:

(1) Will an interpreter looking at an enlargement made on this instrument be able to extract more information from it than he could from an enlargement made on any other enlarger of comparable format size?

(2) The outer portions of the format exhibit astigmatic effects. If the answer to question one is affirmative, operation with a reduced effective format could be profitable, especially in view of the fact that the exact format size represents an aribtrary choice. The question is, are the astigmatic effects sufficiently detrimental so as to warrant an improvement effort?

F. FUTURE EFFORTS

All those concerned with this project are eager to understand this instrument more fully. Therefore, future efforts may be devoted to the following subjects:

(a) Optical Performance

(b) Spatial Filtering

(c) Artifact Elimination

In addition to the above, the items covered in Section 9, General Acceptability, might also be the subject of future efforts.

G. REFERENCES

25X1A

1. [redacted] Engineering Report No. 7354

2. Technical Memorandum LC101

3. Technical Memorandum WEO'B101

H. RELEVANT REPORTS

Operator's Manual for Coherent Enlarger (Prototype Unit)

Technical Memorandum MDR106 - "Change of Refractive Index with Temperature"

Technical Memorandum REH108 - "Change of Refractive Index with Temperature"

Letter to MDR from FS 22 May 1964

Memo to LC from ASM 20 March 1964

Memo to LC from ASM 3 April 1964

Technical Memorandum JLK101, "Maximum Utilization of Laser Energy in a Collimated Beam"

Technical Memorandum JLK103 "Quasi Coherent Imagery"

Technical Memorandum JLK104 "Coherent Images of Conventional Targets"

Technical Memorandum JLK106 "Lens Tolerance for Optics Utilizing Coherent Light"

Technical Memorandum JLK107 "Some Comments on Coherent Imagery"

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

APPENDIX A

25X1A

TO: [redacted]

FROM:

DATE: 18 August 1964

SUBJECT: Alternate Source

Second Source Requirement

As an instrument utilizing the properties of coherent light, the enlarger is designed to operate with a helium-neon laser as the prime source of illumination. The laser fulfills the functions of providing monochromatic light having full coherence; however, it cannot be said that this source is ideal under all circumstances for purposes of photographic reproduction. Particularly in the light of the preliminary breadboard experimentation, it has become evident that for some purposes light source requirements exist that are not readily fulfilled by the laser. Specifically, the helium-neon laser presents difficulties in the following respects.

1. The degree of coherence is not readily controllable (where departure from full coherence is required).

2. The laser wavelength is not suitable for critical visual test purposes, and for some photographic purposes.

3. Laser output illuminations under some circumstances lead to excessive exposures.

These difficulties are met by providing the enlarger with an alternate illumination source comprised of a sodium vapor lamp in conjunction with an appropriate auxiliary source optical system.

Alternate Source Selection

Alternate source requirements were studied during the course of the enlarger breadboard experiments. Some trials were made with an incandescent lamp in conjunction with a narrow band filter, but it became evident that the lack of chromatic correction in the optical system led to excessive requirements in respect to bandwidth limitation. A zinc vapor lamp was tried briefly — this source having a wavelength close to that of the laser, but with relatively low output and no improvement over the laser in respect to visibility.

25X1A

The eventual selection was an [redacted] sodium vapor lamp. This operates at a wavelength of 5890 Å — this being close enough to laser wavelength of 6328 Å so that no optical system color correction problems are encountered.

Since the color is close to the sensitivity peak of the eye, the visibility function is excellent (five times that of laser light). This is of importance in visual optical test procedures. Finally, this lamp provides a high light output in a bulb size suitable for the required semi-extended source configuration.

Source Description

In the prototype enlarger, the alternate source system is located beneath the laser; and is brought into use, when required, by the actuation of an auxiliary mirror. The alternate source system is shown in the appended sketch.

The sodium lamp, which presents an illumination source of 1/2-inch diameter, is reimaged by a condenser lens pair at an adjustable iris. An isolation filter in the condenser system suppresses the incandescent radiation from the lamp electrodes and eliminates sodium spectrum lines other than the pair at 5890 Å. The adjustable iris diaphragm is projected by collimator lenses, and is eventually reimaged at the transform plane of the imaging optical system, the degree of coherence being regulated by adjusting the iris opening. The collimator lens system is comprised of the main collimator lens (used with the laser source) in conjunction with an auxiliary collimator lens which acts to shorten the effective focal length of the collimator system as required for correct magnification in reimaging the iris.

A separate power supply for the sodium lamp is located in the main control rack. The alternate source illumination is controlled by a separate shutter which is automatically switched into the timing control circuit when the auxiliary mirror is operated.

The sodium vapor and laser sources are quite dissimilar in regard to means of varying coherence and in the relations between degree of coherence and exposure.

From the standpoint of illumination at the film plane, and consequently exposure time, the laser performs most efficiently when used at full coherence. Any means used to reduce coherence will in general also reduce its efficiency as a light source. If, for example, the departure from coherence were obtained by the introduction into the beam of a diffusing plate having a variable degree of diffusion, then the exposure time would increase as the coherence decreased, due to loss of illumination efficiency by diffusion.

25X1D

25X1D

25X1D

As an adjunct to the laser as a primary source of illumination, an auxiliary source is available, based on a sodium vapor lamp. It is expected that this additional source system will be of value in certain operational and experimental work, particularly in providing:

1. A readily controllable and measurable amount of coherence.

2. A source having a high visibility function.

3. Shorter exposure times than those obtainable with the laser (at less than full coherence).

25X1D

APPENDIX B

7 August 1964

25X1D

[redacted] WEEKLY PROGRESS REPORT

This week was spent in an attempt to obtain the Modulation Transfer Function of the enlarger under varying lighting conditions. Unfortunately this information has been difficult to obtain because our light sources and our film processing procedures are not "in the books" Results are summarized below:

25X1D

A. [redacted] Film developed in diluted D-76 for which no transfer function information is available. Assume values shown in column b:

25X1D

[redacted]

B. Assume transfer function of film is unity and normalize on basis that item 50C should also be unity:

25X1D

[redacted]

25X1D
25X1D
25X1D

The apparent drop in the transfer function [redacted] [redacted] is due to the fact that the three targets were simultaneously spread out in the field and the [redacted] target was at a point of poor resolution. The results are plotted on the attached graph; note the word TENTATIVE!

In addition to the above retrofit work was accomplished on the vertical transport drive to permit wider variations of film weight.

25X1A

[redacted]

cmw

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

APPENDIX C

August 21, 1964

COHERENT LIGHT ENLARGER

25X1D [redacted]

Weekly Progress Report

A considerable number of sine wave target enlargements were made and processed in an attempt to further determine the modulation transfer function of the instrument.

One group of enlargements was intended to determine variation of transfer function with format position andtarget orientation. All the enlargements of this group were made using the sodium lamp with the source iris adjusted to effect 90% coherence. The two orientations used were tangential and radial with respect to the format center. See Fig. 1.

A second group was intended to determine the variationof transfer function with degree of coherence. The following results were obtained with a target consisting of two sine wave frequencies [redacted]

25X1D

25X1D

These results are plotted in Figure 2.

Because of the scatter observed in the above results and in the present absence of more reliable test methods it has been decided that the acceptance criterion of this instrument shall be its ability to make enlargements with greater information retention than that of any non-coherent enlarger now used by the customer. These enlargements are to be completed and compared by 28 August.

25X1A [redacted]

LC:lc

* Refers to Eng. Notebook No. 2005, Vol. II p. 73.

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

25X1D

Next 1 Page(s) In Document Exempt

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

APPENDIX D

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

TO: [redacted] DATE: 19 August 1964

25X1A

FROM: [redacted]

SUBJECT: Optical System Performance

Background

Following assembly and alignment of the enlarger optical system early in May, 1964, photographic testing was started to check the optical performance of the system. It very quickly developed from these tests that performance was excellent in the central region of the image field, but that degradation occurred in the outer portion. Further tests quickly established that Lens No. 1 (projection lens) was the element of the system causing the degradation.

There followed an extended period of tests of various types on Lens No. 1 in an attempt to ascertain the nature of the deficiency, which proved very elusive. Details of the various test procedures and results are described in Engineering Note Book No. 2125, and detailed memorandum presently in preparation.

Briefly, it appears now that the original difficulties with Lens No. 1 were in part due to an accumulation of minor inaccuracies in the mounting of the elements, but were also in part due to the optical design. Considerable improvement was made in the lens by remounting the elements using improved means for obtaining concentricity and with some slight air space adjustments. It appears probable that the resolution problems remaining in the lens after final reassembly (to its present condition) largely reflect conditions remaining in the optical design.

Aerial Image Tests

Following final reassembly of the lens, further optical tests were made (using laser star image techniques) and (on June 25) after reassembly of the lens in the system, visual 3-bar target tests were made. In these tests, the emphasis was on incoherent (sodium) light observations, since the purpose was to check the optical quality of the system, but some tests were made using a high coherence. The results under the two conditions are very similar when the effects of spurious resolution are discounted.

25X1D

[redacted]

25X1D

Photographic Tests

Following the above visual tests, repeated photographic test runs were made using various targets and under various degrees of coherence in both laser and sodium illumination. Qualitatively, the results are similar to visual observations, but with a reduction in the numerical results in lines millimeter resulting from the film function.

The following graphs, taken from a photographic run of August 6 were reduced primarily as an aid in evaluating the correlation of the system performance with optical design data. However, the results are characteristic, and descriptive of the present optical performance of the enlarger.

The runs were made using the reduced target strip film mentioned above. The illumination was sodium at 80 percent coherence.

Approved For Release 2002/09/03 : CIA-RDP78B04747A001700020002-0

25X1D

Next 15 Page(s) In Document Exempt

STATINTL

MEMORANDUM FOR: [redacted]

These two documents are controlled. Do not give them to anyone without letting me know first.

STATINTL

[redacted] (DATE) 10 Sept.

FORM NO. 101 REPLACES FORM 10-101
1 AUG 54 WHICH MAY BE USED.

(47)

TOP SECRET

File under [redacted] 624

NRO
25X1

25X1A

Received of [redacted] the following four items classified TOP SECRET-OXCART:

(1) ON Chip
(2) Print #18 (Laser source with diffuser, ~85% coherence)
(3) Print #20 (Sodium source, ~80% coherence)
(4) Print #21 (Sodium source, ~80% coherence with trial spatial filter)

25X1A

[redacted]
12 August 1964

mb

TOP SECRET

CONTAINS NEGATIVES CONTRACT

25X1
NRO

TOP SECRET

This document contains information referring to Project [illegible]

TOP SECRET